National Aeronautics and Space Administration

NASA on Earth

Advancing Food, Water,
and Safety for Communities

partner

www.nasa.gov

NASA on Earth

When faced with a difficult problem, it is good to get a little distance from it so as to gain new perspectives. At NASA we do just that by examining Earth from space and capturing information to help address our most formidable challenges and make life better for people on the ground.

We have been monitoring a wide array of pressing global challenges facing communities around the world. Recently, we prioritized three of the most critical issues—food security, freshwater availability and natural disasters—that demand our attention and much more innovative approaches on a larger scale.

There is extraordinary untapped potential for Earth science to drive improved forecasting and decision-making on these three interconnected issues. The extensive Earth observing system NASA has built can help. It is the largest such system in the world, offering anyone free and unparalleled access to high-quality data and models about how the Earth's natural and built environments are changing.

But the power of data is realized only when it is owned and used by people on the ground. This is why we are so passionate about connecting with partners that are already creating positive change in the world. We want to identify what we need to learn and where we can help leverage the powerful information we have to create even greater societal benefits.

Let's talk.
Together, we can improve life on Earth.

Sincerely,

Lawrence Friedl

Director, Applied Sciences
Earth Science Division
NASA

Introducing NASA on Earth

From land, air and space, NASA monitors Earth's vital signs all over the globe. We know that Earth's capacity to sustain life is changing as our population grows and our climate changes. These changes will affect every aspect of existence on our planet.

While many people appreciate NASA's emphasis on exploring space, our focus on planet Earth is far less understood. At NASA we use our Earth observing system to monitor changes in our planet's natural and built environments across entire continents, whole oceans and everything in between. The power of this system comes from Earth observing satellites that continually orbit our planet, use of the International Space Station, NASA air and ground observations, extensive archives of global data sets and a team of expert scientists, all working in unison with our public- and private-sector partners like you.

NASA satellites specialize in collecting specific information about the Earth's environment, such as changes in sea levels, air quality and forest cover. These observations are augmented by airborne and ground measurements that provide a connection between what is happening on the ground and what the satellites are measuring from space. This helps ensure that the information is as accurate as possible. And the data gathered on any given day can be compared to and contrasted with observations gathered over time—in some cases more than 40 years—to understand changes and model the future.

In short, NASA maintains the world's largest system for collecting, synthesizing, archiving, interpreting and distributing scientific data about our planet. And it's all free and open to the world.

Why We Do It

As part of NASA's larger mission to advance scientific understanding and promote innovation, we are driven by a sense of responsibility to apply what we're seeing and learning to humanitarian needs on a global scale.

At NASA we invest in this work because we believe science plays an essential role in society. When successfully applied, science informs wise decision-making and helps people predict and prepare for the future.

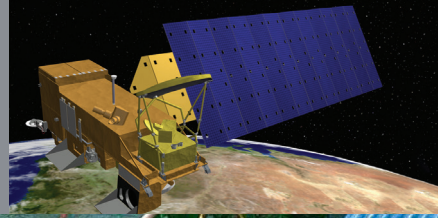
At the end of the day, science drives great advances in human history and paves the way for important societal evolution.

But science doesn't do it alone. We are increasingly aware that putting science out into the world is not enough. We need to understand how the knowledge is applied on the ground, whether and how our data and models prove useful, and what additional questions and needs surface as a result.

To accomplish this we need to work more closely with those who use NASA information and are at the forefront of addressing humanitarian needs. We need and want to do more to help ensure that scientific knowledge is applied to make positive differences in the world.

And that brings us to you…

Urgent Global Challenges



When people come to NASA to access the knowledge we offer about planet Earth, we pride ourselves on being responsive. Our aim is to maximize the benefit to be gained from our work and enhance the return on investment that the U.S. is making in Earth observations.

Recently we decided to be more intentional in proactively seeking out partners on three global challenges—**freshwater availability**, **food security** and **natural disasters**. We selected these three challenges because we believe NASA can significantly contribute to solutions in ways that have yet to be fully explored. We also anticipate that these three issues will become ever more central to the future of humanity given forecast trajectories of population growth and global warming.

The good news is that there are hundreds of non-governmental organizations, multinational companies, foundations and public institutions like yours actively working around the globe to address these three challenges. Our goal is to work more closely together to better apply Earth science. We aim to put the power of Earth observations and greater scientific understanding in your hands and use it to spark innovation on a scale the world has yet to see.

Explore with us now the interconnected issues of freshwater availability, food security and natural disasters and how a partnership with NASA can make a difference.

Freshwater Availability

The Earth's supply of freshwater is finite, and all people rely on it for their survival. Where water is plentiful, society can thrive. But where it is constrained, society can falter. With billions more people projected to inhabit planet Earth in the next few decades, consuming ever more water as the population grows, there is no question that freshwater availability will become a major determining factor for human health and prosperity in the 21st century.

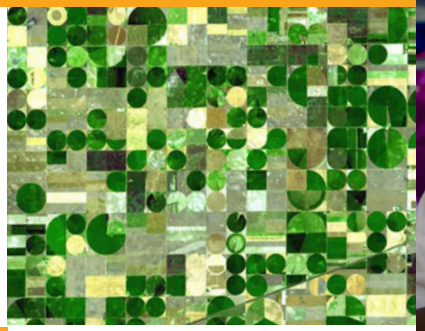
The world needs ongoing and timely information on freshwater supplies to prepare for changes in where people can live and how much water they can sustainably use. However water is constantly cycling through rain, snow, runoff, evaporation and so on. In addition, much of the world's freshwater is hard to assess, held in ice caps or hidden deep beneath the Earth's surface.

NASA is unique in its capacity to study and monitor the entire freshwater cycle on Earth. We use geodetic means to observe variations in the total water stored on and beneath the Earth's surface. When the amount of water stored in a region increases, the gravitational pull from that area also increases proportionately, a change that NASA satellites can detect and use to measure freshwater supplies. And with the launch of the *SMAP* satellite, we have an orbiting observatory to measure and map the amount of water in the top two inches of soil everywhere on the Earth's surface.

World Resources Institute has tapped into NASA's knowledge of water resources for its Aquaduct tool to measure, map and understand water risks around the globe. Researchers have also used NASA's ability to track changes in water over time to study how growth of a cotton industry in the deserts of Central Asia led to the drying up of the Aral Sea (which was the world's fourth-largest saline lake). And the state of California demonstrated how NASA technology can be used to quantify water reserves in high-altitude snowpacks across an area 46 million times larger than what it could measure without NASA's help.

In Gujarat, India, where groundwater has been disappearing over the past decade due to overpumping, NASA satellites have helped map and reveal a dramatic shift in groundwater levels. The insights have influenced people's thinking about how to use water resources in the region far more sustainably.

Food Security



Our planet can produce enough food to feed everyone, though more than 800 million people still suffer from chronic hunger. In many of the world's prime growing areas—from California's Central Valley to the plains of sub-Saharan Africa—erosion and drought are destroying arable land and creating a "dust bowl" situation.

The world needs innovative new ways to get more crops per drop. While the world's emphasis has focused for decades on building water supplies and irrigation to bolster crop yields, a new era is dawning that places equal emphasis on creating early warning systems, restoring degraded waters and enhancing water efficiency. NASA's system of Earth observing satellites plays a unique role at the forefront of this evolution.

For example, CGIAR, a global agricultural research partnership, has used NASA data to reveal hotspots of land and water degradation in need of rehabilitation. NASA scientists have made public a new Mapping Evapotranspiration technique, which uses satellites to track the amount of heat in fields to inform irrigation needs and reduce water waste on a field-by-field basis. Our long-standing relationships with aid agencies, the United Nations and users of the Famine Early Warning System have benefited from space-based measures of crop health, critical for improving crop yield forecasts and targeting humanitarian food assistance to the areas that need it most. And improved information on soil moisture from the upcoming *SMAP* satellite will bring further enhancements.

Mosquitoes, sand flies and tsetse flies transmit deadly diseases that devastate livestock all across Africa. NASA is proving that a good way to counter these tiny menaces is through information from space. By helping local communities access satellite data on environmental factors that contribute to disease outbreaks, NASA enables ranchers to be alerted to areas and periods of higher risk before they lose livestock. They can even get these reports on their mobile devices.

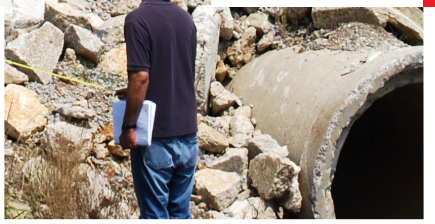
Natural Disasters

For those in the path of destruction when natural disasters strike, everything changes. People find themselves homeless and hungry, their savings are washed away, children are separated from families, schools and medical facilities are closed, and the list goes on. Recent experiences with superstorms, wildfires, earthquakes and volcanic eruptions demonstrate just how destructive natural disasters can be.

In an era of climate change, we can anticipate that impacts from natural disasters will worsen as warming oceans trigger more frequent storm events, drying and dying forests become more fire prone, and new parts of the planet are opened up for development.

When it comes to natural disasters, the world needs vulnerability assessments to build more resilient communities, early warning systems to get people out of harm's way, and rapid data and mapping capabilities to inform disaster response. NASA can support organizations with the information they need to successfully improve efforts on all these fronts.

For example, in the Rocky Mountains of the United States, a coalition of groups is relying on NASA data and models to evaluate land management options that can build resilience and prevent catastrophic fires in forests decimated by disease and invasive pests. On the other side of the world, the Institute of Water Modeling in Bangladesh merged NASA satellite data with flood forecasts to help 160 million citizens nearly triple their preparation window for flood events. And when Typhoon Haiyan hit the Philippines in 2014, first responders from around the world used NASA data and maps to rapidly detect damage and safe zones for relief distribution centers.



The U.S. Department of Homeland Security and NASA developed a new radar-based technology to detect a human heartbeat in a body buried beneath 30 feet (9 meters) of crushed material. This capability complements current urban search and rescue tools such as canines, listening devices and video cameras to detect the presence of living victims in rubble.

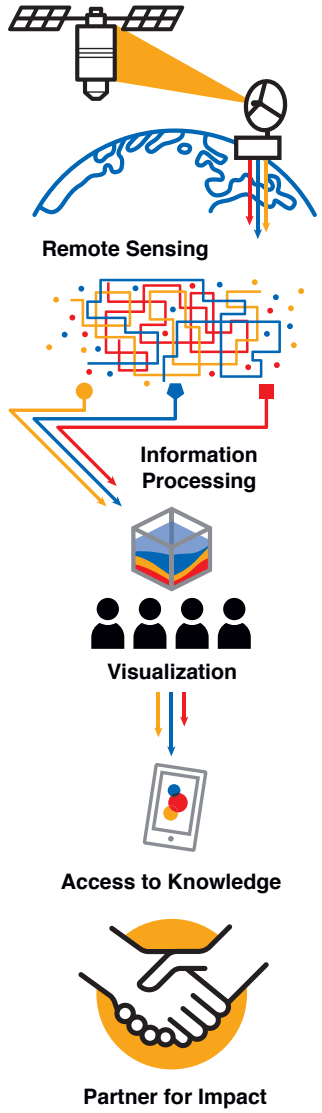
NASA Services Delivered

From water to food to natural disasters, NASA makes a difference through its operation of 18 environmental satellites that continually orbit our home planet, the International Space Station, and robotic planes that fly to altitudes of 60,000 feet. Together, NASA's space-borne assets like *Terra*, *Aqua* and *Landsat* satellites; airborne instruments like radar and lidar; and more than a dozen data-processing and storage centers we call "DAACs" provide an unparalleled ability to examine and interpret the forces affecting all life on Earth.

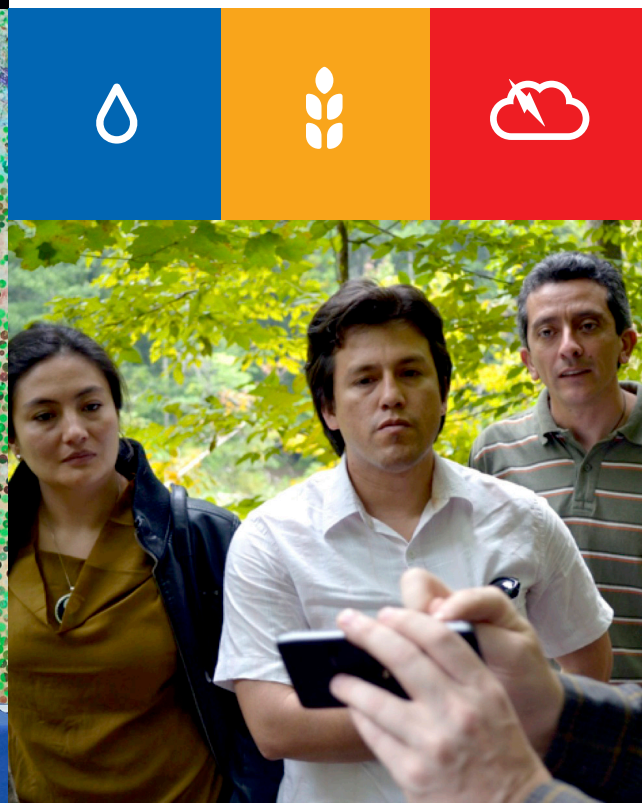
By leveraging these NASA assets, in unison with scientists stationed at our centers across the country, we are able to:

- Offer unparalleled access to large datasets collected and maintained over multiple years and, in some cases, decades, free for use by anyone
- Seek out new users and new challenges for innovative and practical ways to use NASA data and expand our research
- Produce high-quality satellite imagery that helps people make sense of what data looks like on the ground
- Interpret and share knowledge to enable others to make more informed decisions on issues related to water, food and disasters
- Develop and maintain modeling capabilities that allow people to apply data to forecast the future
- Train those who seek to strengthen their capacity to access and leverage NASA Earth observation data
- Integrate satellite observations, ground-based data and forecast models to help developing nations monitor, predict and respond to environmental changes
- Engage users of NASA data in satellite mission planning to examine application aspects and opportunities to best leverage each new satellite

And NASA works in coordination with other U.S. federal agencies and space agencies around the world, bringing together capabilities and data sets to deliver enhanced value.



Let's Get to Work



The challenges of ensuring freshwater availability, increasing food security, and preparing for and responding to natural disasters are too big for any one organization to meet alone. But together we can leverage enhanced knowledge of planet Earth as a key to creating healthier livelihoods, economies and environments.

To do this, we need to strengthen awareness on the unique benefits of Earth observations; adapt how we collect, interpret and package data for enhanced usability; and put knowledge into the hands of important leaders who are positioned to make a difference in communities across the world.

Join us in exploring what we can do together to improve life on Earth. Let's talk.

NASA on Earth Leadership

Charles F. Bolden, Jr.

Administrator

Michael Freilich, PhD

Director,
Earth Science Division

Margaret Luce

Deputy Director,
Earth Science Division

Lawrence Friedl

Director, Applied Sciences,
Earth Science Division

FOR MORE INFORMATION:

National Aeronautics and Space Administration
300 E Street, SW
Washington, D.C. 20546

www.nasa.gov/earthrightnow

NP-2015-03-1484-HQ